WHAT IS CLAIMED IS:

1. A waveguide-type optical control device comprising:

first and second directional couplers provided while leaving a predetermined spacing therebetween, said first and second directional couplers being constituted respectively by two right and left optical waveguides provided on a substrate; and

a control unit provided between the first directional coupler and the second directional coupler, first, second, and third electrodes being provided respectively on the left side of the left optical waveguide, on the right side of the right optical waveguide, and between the two optical waveguides, said control unit functioning to control light, which passes through the two optical waveguides, according to a voltage applied to the first, second, and third electrodes,

said first, second, and third electrodes being extended into the first and second directional couplers.

2. The waveguide-type optical control device according to claim 1, wherein the first and second electrodes are different from each other in shape.

3. The waveguide-type optical control device according to claim 1, wherein the first, second, and third electrodes are extended to a portion near the boundary between the first directional coupler and the control unit and the boundary between the second directional coupler and the control unit.

4. The waveguide-type optical control device according to claim 1, wherein the first, second, and third electrodes have been offset to the right or left side with respect to the center line between the two optical waveguides.

5. The waveguide-type optical control device according to claim 1, wherein the control unit is a phase shifter that controls the quantity of light, which passes through the two optical waveguides, according to the applied voltage.

6. A waveguide-type optical control device comprising:

a phase shifter provided with a first electrode section comprising an electrode provided on the left side of a left optical waveguide, an electrode provided on the right side of a right optical waveguide, and an electrode provided between the two optical waveguides; and

a directional coupler comprising two optical waveguides which are connected respectively to the two right and left optical waveguides in the phase shifter and are provided parallel to each other with the spacing between the two optical waveguides being partially reduced, said directional coupler being used in at least one of an optical branching section provided on the input side of the phase shifter and an optical coupling section provided on the output side of the phase shifter, the refractive index of the two optical waveguides being varied according to a voltage applied across the electrodes provided respectively on the left side of the left

optical waveguide and the right side of the right optical waveguide and the electrode provided between the two optical waveguides in the phase shifter,

said directional coupler being provided with a second electrode section comprising an electrode provided on the left side of the left optical waveguide, an electrode provided on the right side of the right optical waveguide, and an electrode provided between the two optical waveguides, the three electrodes constituting the second electrode section being electrically connected respectively to the three electrodes constituting the first electrode section provided adjacent to the second electrode section in the longitudinal direction of the two optical waveguides, the voltage applied to the first electrode section being applied to the second electrode section.

7. The waveguide-type optical control device according to claim 6, wherein the second electrode section has been formed by extending the electrodes constituting the first electrode section.

8. The waveguide-type optical control device according to claim 6, wherein the second electrode section has a construction such that the shape of the electrode provided on the left side of the left optical waveguide and the shape of the electrode provided on the right side of the right optical waveguide are asymmetrical.

9. The waveguide-type optical control device according to

claim 6, wherein the second electrode section is provided only at a portion near the boundary between the directional coupler and the phase shifter.

10. The waveguide-type optical control device according to claim 6, wherein the first electrode section and the second electrode section have been offset by a predetermined level with respect to the center line between the two optical waveguides.

11. The waveguide-type optical control device according to claim 6, wherein, in the second electrode section, the electrode provided on the left side of the left optical waveguide and the electrode provided on the right side of the right optical waveguide each comprise a plurality of electrode pieces which are arranged at a predetermined interval and have been connected to each other or one another through a fuse or a bonding wire.

12. The waveguide-type optical control device according to claim 6, wherein the electrode provided between the optical waveguides in the second electrode section partially or entirely overlaps with one of the two optical waveguides in the thicknesswise direction thereof.

13. The waveguide-type optical control device according to claim 6, wherein the second electrode section is disposed on the surface of a substrate on which the two optical waveguides

are provided through a buffer layer.

14. The waveguide-type optical control device according to claim 6, wherein each of the electrodes constituting the second electrode section is disposed so as to be substantially coplanar with the two optical waveguides.

15. The waveguide-type optical control device according to claim 14, wherein the electrodes constituting the second electrode section are provided within respective concaves provided on the surface of a substrate on which the two optical waveguides are provided.

16. The waveguide-type optical control device according to claim 6, wherein the second electrode section is disposed on the backside of a substrate on which the two optical waveguides are provided.

17. The waveguide-type optical control device according to claim 6, 7, 8, 9, 10, 13, or 16, wherein the directional coupler is provided in each of the optical branching section and the optical coupling section and both the directional couplers are provided with the second electrode section.

18. A waveguide-type optical control device comprising:

a phase shifter comprising two left and right optical waveguides, a first electrode provided on the left side of the left optical waveguide, a second electrode provided on the

right side of the right optical waveguide, and a third electrode provided between the two optical waveguides;

a first directional coupler that is connected to one end of the phase shifter and functions to branch an optical signal introduced through one of the two optical waveguides into optical signal parts which are then introduced respectively into the two optical waveguides; and

a second directional coupler that is connected to the other end of the phase shifter and functions to couple the optical signal parts received respectively from the two optical waveguides,

at least one of the first and second electrodes and the third electrode having been extended into a part or the whole of the first directional coupler or the second directional coupler.

19. A waveguide-type optical control device comprising:

a phase shifter comprising two left and right optical waveguides, a first electrode provided on the left side of the left optical waveguide, a second electrode provided on the right side of the right optical waveguide, and a third electrode provided between the two optical waveguides;

a first directional coupler that is connected to one end of the phase shifter and functions to branch an optical signal introduced through one of the two optical waveguides into optical signal parts which are then introduced respectively into the two optical waveguides; and

a second directional coupler that is connected to the

other end of the phase shifter and functions to couple the optical signal parts received respectively from the two optical waveguides,

at least one of the first and second electrodes and the third electrode having been extended into a part or the whole of the first directional coupler, at least one of the first and second electrodes and the third electrode having been extended into a part or the whole of the second directional coupler.

20. A waveguide-type optical control device comprising:

a phase shifter comprising two left and right optical waveguides, a first electrode provided on the left side of the left optical waveguide, a second electrode provided on the right side of the right optical waveguide, and a third electrode provided between the two optical waveguides;

a first directional coupler that is connected to one end of the phase shifter and functions to branch an optical signal introduced through one of the two optical waveguides into optical signal parts which are then introduced respectively into the two optical waveguides; and

a second directional coupler that is connected to the other end of the phase shifter and functions to couple the optical signal parts received respectively from the two optical waveguides,

said first directional coupler comprising, in its directional coupling section, first directional coupling section outer electrodes disposed respectively at a portion near the left side of the left optical waveguide and at a

portion near the right side of the right optical waveguide in the first directional coupling section and a first directional coupling section intermediate electrode disposed between the two optical waveguides in the first directional coupling section,

said first electrode and said second electrode having been electrically connected respectively to the first directional coupling section outer electrodes, said third electrode having been electrically connected to the first directional coupling section intermediate electrode.

21. The waveguide-type optical control device according to claim 20, wherein the first directional coupling section outer electrodes and the first directional coupling section intermediate electrode apply a voltage to a part of the optical waveguides constituting the directional coupling section to cause an electric field.

22. A waveguide-type optical control device comprising:

a phase shifter comprising two left and right optical waveguides, a first electrode provided on the left side of the left optical waveguide, a second electrode provided on the right side of the right optical waveguide, and a third electrode provided between the two optical waveguides;

a first directional coupler that is connected to one end of the phase shifter and functions to branch an optical signal introduced through one of the two optical waveguides into optical signal parts which are then introduced respectively

into the two optical waveguides; and

a second directional coupler that is connected to the other end of the phase shifter and functions to couple the optical signal parts received respectively from the two optical waveguides,

said second directional coupler comprising, in its directional coupling section, second directional coupling section outer electrodes disposed respectively at a portion near the left side of the left optical waveguide and at a portion near the right side of the right optical waveguide in the second directional coupling section and a second directional coupling section intermediate electrode disposed between the two optical waveguides in the second directional coupling section,

said first electrode and said second electrode having been electrically connected respectively to the second directional coupling section outer electrodes, said third electrode having been electrically connected to the second directional coupling section intermediate electrode.

23. The waveguide-type optical control device according to claim 22, wherein the second directional coupling section outer electrodes and the second directional coupling section intermediate electrode apply a voltage to a part of the optical waveguides constituting the directional coupling section to cause an electric field.

24. The waveguide-type optical control device according

to claim 20 or 21, wherein the first directional coupling section intermediate electrode has been offset with respect to the center line between the two optical waveguides constituting the first directional coupling section.

25. The waveguide-type optical control device according to claim 22 or 23, wherein the second directional coupling section intermediate electrode has been offset with respect to the center line between the two optical waveguides constituting the second directional coupling section.

26. A variable optical attenuator comprising:

a phase shifter provided with a first electrode section comprising an electrode provided on the left side of a left optical waveguide, an electrode provided on the right side of a right optical waveguide, and an electrode provided between the two optical waveguides; and

a directional coupler comprising two optical waveguides which are connected respectively to the two optical waveguides in the phase shifter and are provided parallel to each other with the spacing between the two optical waveguides being partially reduced, said directional coupler being used in at least one of an optical branching section provided on the input side of the phase shifter and an optical coupling section provided on the output side of the phase shifter, the refractive index of the two optical waveguides being varied according to a voltage applied across the electrodes provided respectively on the left side of the left optical waveguide and

the right side of the right optical waveguide and the electrode provided between the two optical waveguides in the phase shifter, whereby the attenuation level of the lights passed through the optical waveguides is controlled,

said directional coupler being provided with a second electrode section comprising an electrode provided on the left side of the left optical waveguide, an electrode provided on the right side of the right optical waveguide, and an electrode provided between the two optical waveguides, the three electrodes constituting the second electrode section being electrically connected respectively to the three electrodes constituting the first electrode section provided adjacent to the second electrode section in the longitudinal direction of the two optical waveguides, the voltage applied to the first electrode section being applied to the second electrode section.

27. An optical equalizer comprising:

an optical demultiplexer into which a wavelength multiplexed optical signal containing a plurality of optical signals with one or mutually different wavelengths is input and which demultiplexes the wavelength multiplexed optical signal into optical signals and outputs the demultiplexed optical signals;

the variable optical attenuator according to claim 26 which selectively attenuates the demultiplexed optical signals by a predetermined attenuation level and outputs the attenuated optical signals; and

an optical multiplexer for multiplexing the attenuated

optical signals output from the variable optical attenuator.

28. The optical equalizer according to claim 27, which further comprises an attenuation level control circuit for controlling the variable optical attenuator so as to render the optical levels of the attenuated optical signals homogeneous.

29. The optical equalizer according to claim 27, which further comprises an attenuation level control circuit for controlling the variable optical attenuator in such a manner that a predetermined difference is provided between the optical levels of the attenuated optical signals.

30. An optical inserting/separating apparatus comprising:

an optical demultiplexer into which a wavelength multiplexed optical signal containing a plurality of optical signals with one or mutually different wavelengths is input and which demultiplexes the wavelength multiplexed optical signal into optical signals and outputs the demultiplexed optical signals;

a wavelength varying filter for selectively separating an optical signals with predetermined wavelengths from the demultiplexed optical signals;

the variable optical attenuator according to claim 26 which selectively attenuates the demultiplexed optical signals, which have passed through the wavelength varying filter, by a predetermined attenuation level and outputs the attenuated optical signals; and

a filter which selects and outputs the attenuated optical signals from the variable optical attenuator or externally inserted optical signals; and

an optical multiplexer for multiplexing the attenuated optical signals output from the filter or the inserted optical signals.

31. The optical inserting/separating apparatus according to claim 30, which further comprises an attenuation level control circuit for controlling the variable optical attenuator so as to render the optical levels of the attenuated optical signals and the inserted optical signals homogeneous.

32. The optical inserting/separating apparatus according to claim 30, which further comprises an attenuation level control circuit for controlling the variable optical attenuator so as to provide a predetermined difference between the optical levels of the attenuated optical signals and the inserted optical signals.

33. A waveguide-type optical control device comprising:

a phase shifter comprising two left and right optical waveguides, a first electrode provided on the left side of the left optical waveguide, a second electrode provided on the right side of the right optical waveguide, and a third electrode provided between the two optical waveguides;

a first directional coupler that is connected to one end of the phase shifter and functions to branch an optical signal

introduced through one of the two optical waveguides into optical signal parts which are then introduced respectively into the two optical waveguides; and

a second directional coupler that is connected to the other end of the phase shifter and functions to couple the optical signal parts received respectively from the two optical waveguides,

at least one of the first and second electrodes and the third electrode having been extended into a part or the whole of the first directional coupler or the second directional coupler, the third electrode in its extended electrode portion being provided so that a longitudinal electric field is applied to one of the two optical waveguides.

34. The waveguide-type optical control device according to claim 33, wherein the third electrode in its extended electrode portion is disposed on the top surface or the backside of one of the two optical waveguides so as to overlap therewith.

35. A process for producing a waveguide-type optical control device, comprising the steps of:

forming two right and left optical waveguides so as to construct a phase shifter and at least one directional coupler within a substrate;

forming a first electrode and a second electrode respectively on the left side of the left optical waveguide and on the right side of the right optical waveguide so as to

extend from the phase shifter to a part of the directional coupler, forming a third electrode between the two optical waveguides so as to extend from the phase shifter to a part of the directional coupler, and, in addition, forming a plurality of independent electrode pieces at a predetermined interval at the end of the second electrode and at the end of the third electrode, or forming a plurality of electrode pieces at a predetermined interval connected to each other or one another in a cascade form through a fuse; and

successively wire bonding the necessary number of the plurality of independent electrode pieces from the inner side, or successively fusion cutting the fuse of the necessary number of the plurality of cascaded electrode pieces from the outer side so as to bring the characteristic value of the directional coupler to a desired value.